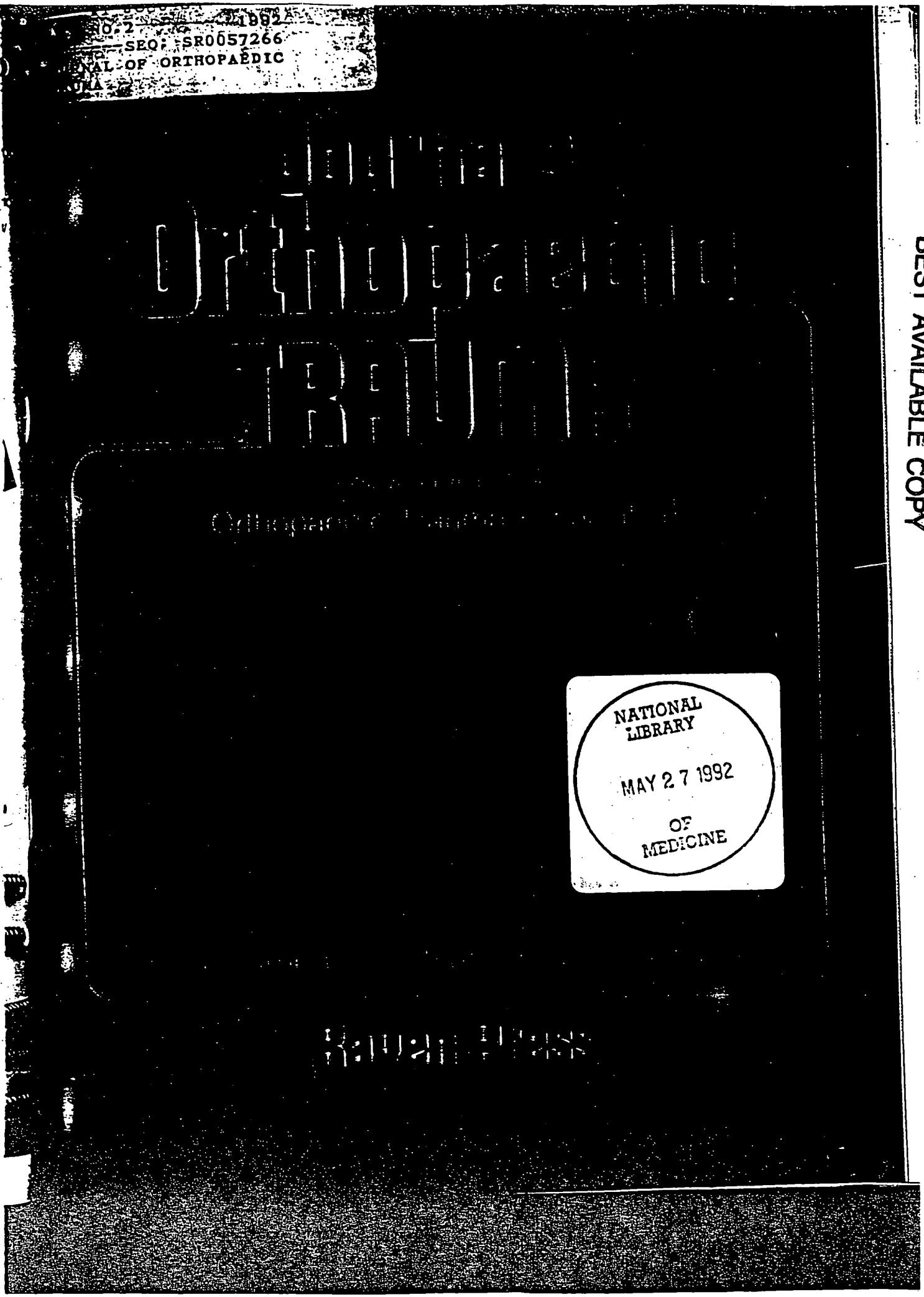

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Case Report

Prophylactic Intramedullary Fixation of the Tibia for Stress Fracture in a Professional Athlete

E. Frederick Barrick and Charles B. Jackson

Department of Orthopaedic Surgery, Georgetown University School of Medicine, Washington, DC, and Department of Orthopaedic Surgery, The Arlington Hospital, Arlington, VA, U.S.A.

Summary: Prophylactic intramedullary nailing of the tibia for stress fracture was performed successfully in a professional football player, enabling him to resume his career. No similar case has been reported previously. Key Words: Stress fracture—Intramedullary fixation—Tibia.

Stress fracture of the anterior tibia can be a disabling injury for a professional athlete (5). Previous reports indicate that treatment can take 6 months to 1 year before the athlete can return to competition (10,20). Such a hiatus of inactivity could end the career of a football player and there is no assurance that the problem would not recur with the resumption of vigorous training (5,6,14). Continued training with a stress fracture has resulted in completion and even displacement of the fracture with further difficulty in treatment (3,5,14). Completion of a stress fracture has occurred without any symptoms (2,5,14).

This case is the first reported of a nondisplaced, or incomplete, stress fracture of the tibia treated with an intramedullary nail. This operation was performed so that the player could continue to play competitive professional football with symptoms abated and with the risk of fracture completion eliminated.

CASE REPORT

A 24-year-old tight end had the gradual onset of pain in his right leg in 1987. He found that running aggravated the condition. When a radiograph revealed a stress fracture of the anterior midshaft tibia, he was advised to rest. The longest period that he did not train was 6 weeks. When he resumed training, the pain recurred. After intermittent periods of rest, no improvement occurred.

In February 1989, while with his previous team, an allograft using a small amount of cancellous bone was performed. After resting for 2 months with no external immobilization, he became asymptomatic. However, when he resumed training, the symptoms gradually recurred and continued with intermittent training.

At the time he was traded to his current team, he was having pain with running but not with walking. Examination showed a well-healed scar over the anterior right tibia at a nontender bony prominence. Radiographs showed a persistent stress fracture of the anterior midtibia (Fig. 1). A reamed, nonlocked intramedullary nailing of the right tibia was performed in October 1989, about 2 years after the onset and 8 months after the bone grafting. Radiographs showed healing of the stress fracture at 6 weeks (Fig. 2).

He started to gradually resume training and although he had some discomfort at the site of the stress fracture, the disabling symptoms did not occur. At 3 months after surgery he was able to run without difficulty. For a short period, about 8 months after the nailing, he developed some pain at the distal tibial metaphysis, but this symptom abated with further training.

Address correspondence and reprint requests to Dr. E. F. Barrick at 1499 Chain Bridge Road, McLean, VA 22101, U.S.A.

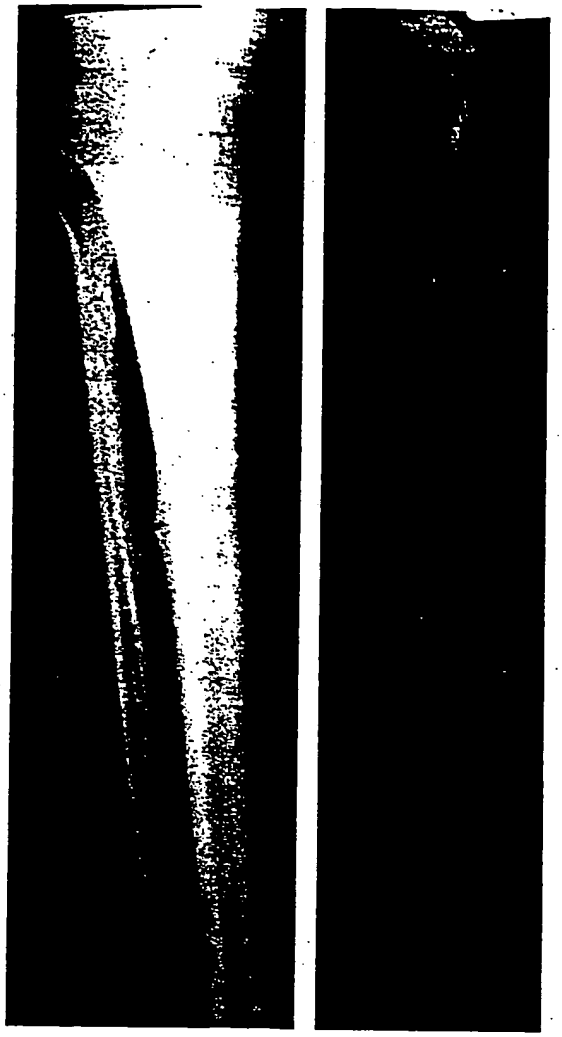

FIG. 1. AP and lateral radiographs showing the stress fracture of the anterior midshaft of the tibia.

Ten months after surgery, he played competitively for the first time in almost 2 years. He remains symptom free 22 months after surgery and is playing as a starter. There is no plan to remove the nail until he stops playing competitive sports, when the risk to recurrence of the stress fracture will be markedly reduced.

DISCUSSION

Stress fracture of the anterior midshaft of the tibia has been reported by a number of authors (5, 6,14). A stress fracture at the anterior margin of the cortex is the result of a tensile force. Stress fractures on the tension side are less likely to heal and have a higher risk of completion and/or displacement in both the tibia (5,14) and the femur (11). Stress fractures also occur at the posterior medial distal tibia (10,18) and the posterior medial proximal tibia (7,9). A stress fracture on the compression side is more likely to heal with rest.

Bone is a biologic supporting structure that will adapt to load. A stress fracture is a reaction to dynamic cyclic loading. With each insult the bone reacts but before the injury can heal a new insult occurs. The load causing such a reaction is excessive, repetitive muscle activity (22). Bone normally has a fairly wide safety margin to functional loading but it can be exceeded in the athlete or soldier. The stiffness of the dynamically loaded bone is not usually exceeded. If it is exceeded, then deformation or actual displacement occurs.

Stress fracture is a result of remodeling under unusual demand. Osteoclastic activity as a result of the loading occurs rapidly, and if loading is continued, the slower osteoblastic activity cannot refill the deficit. Thus, stress fracture is a result of localized accelerated bony resorption due to increased load (4).

Rest is generally considered to be the best treatment for stress fracture (2,3,5,10,11,13,16,22). However, a pneumatic leg brace, used without the athlete curtailing activities, has been successfully used for stress fractures of the distal tibia (12). In this case it could be argued that the patient did not rest sufficiently. However, it has been reported that prolonged rest is needed, especially in stress fractures of the anterior midshaft of the tibia (22). There have been a few cases in which stress fracture of the anterior tibia became complete without any prior symptoms (2,3,14). A combination of rest and pulsed electromagnetic field has been used with mixed results (14,22).

Orava and Hulkko (18) reported treating stress fractures of the anterior midshaft tibia with biopsy and drilling, but these procedures were performed without a trial of rest. Bone grafting has been used successfully in a few cases of stress fracture of the anterior midshaft tibia with complete fracture that failed to unite with cast immobilization (14). Immobilization is needed if bone grafting is used (14). Bone grafting would not seem to have any biomechanical effect on the underlying problem and, therefore, would not be expected to be useful in the nondisplaced or incomplete stress fracture.

The effect of intramedullary reaming alone on the healing of an incomplete stress fracture per se is

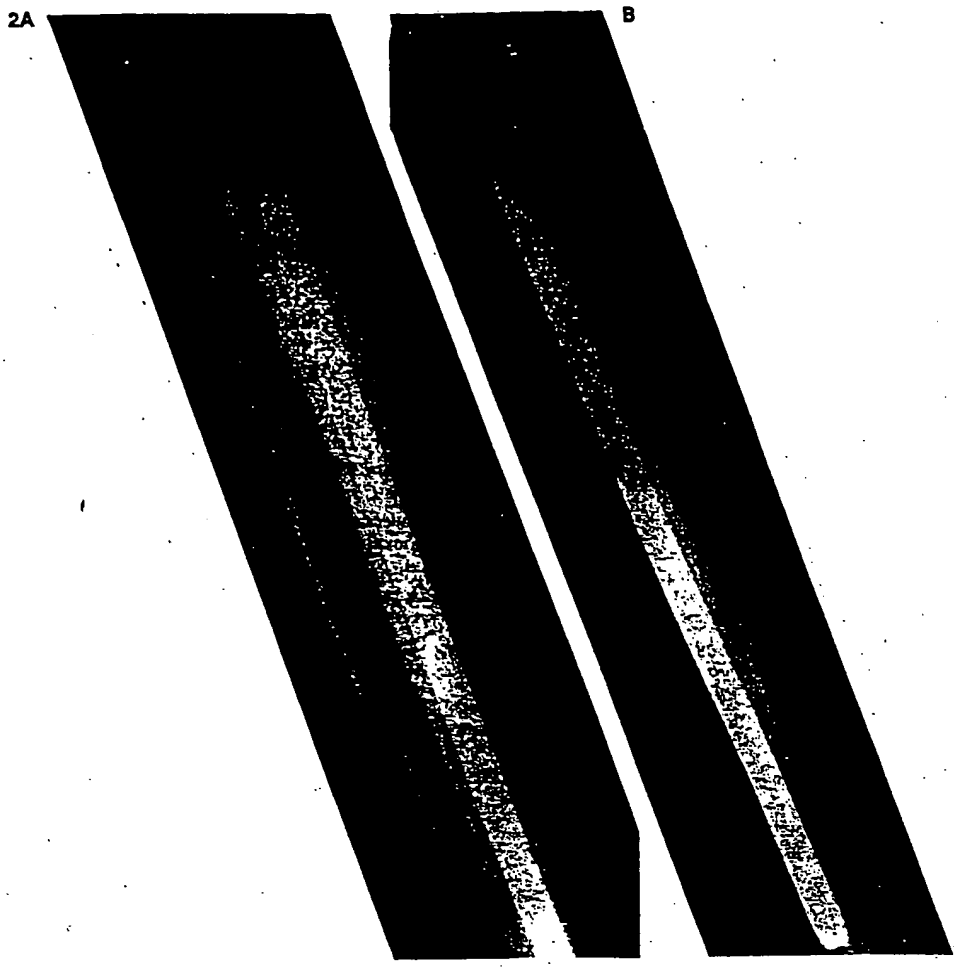

FIG. 2. A and B: AP and lateral radiographs showing the healing stress fracture 6 weeks after intramedullary fixation.

unknown. However, reaming in intact long bones has been shown experimentally to drive marrow into intracortical channels and to stimulate periosteal new bone formation (8). Therefore, reaming alone could be expected to heal an incomplete stress fracture but it is uncertain that the stress fracture would not recur with resumption of vigorous activity.

The use of internal fixation has been used in displaced or completed stress fractures of the femur (1,11,16,23), medial malleolus (21), and ulna (24). Green et al. (14) reported using intramedullary nail fixation to treat a refracture of a previously displaced stress fracture of the anterior midshaft tibia with a successful return to competitive athletics. Prophylactic internal fixation has been proposed for treatment of stress fractures on the tension side of the femoral neck to prevent displacement (11,13,23) and avascular necrosis of the femoral head (23). However, other authors (2,16) believe that internal fixation is not needed for stress fractures of the femoral neck. Prophylactic fixation of tibial stress fractures has not been proposed until this report.

An intramedullary nail provides stress protection, alleviating some of the functional loading (15,19), thus enabling the stress fracture to unite. An intramedullary nail in an osteotomized tibia resists stress better than onlay plates (17). The stiffer the intramedullary nail, whether due to material (19), geometry (19), or size (15), the more it will carry the load and the less bone will experience dynamic load. So the stiffest available intramedullary tibial nail of the largest applicable size was chosen in this case. Reaming was used as it increases the amount of nail contact and thus the degree of load carrying (15). Interlocking was con-

sidered to be unnecessary, as well as undesirable as it could create stress risers.

Intramedullary fixation is probably advisable in a professional athlete as the initial treatment for a completed, and especially for a displaced, stress fracture of the anterior midshaft of the tibia (14). It was used in this instance for the reasons cited in the introduction. Prophylactic fixation is not recommended for an incomplete stress fracture of the anterior tibia in the amateur athlete. Such an individual should be treated with rest, cast or brace immobilization, and/or electromagnetic field. However, when the athlete's livelihood depends on the continuation of training to maintain competitive conditioning, internal fixation would seem justified to eliminate symptoms and to avoid the risk of completion of the stress fracture.

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